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Adopting a Beginners Mind to Craft Experiments that Break the Curse of Knowledge

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Abstract

The experiment and lesson developed in this paper aim at dealing with the curse of knowledge, or the disharmony between what instructors believe they are teaching and what students are learning. This paper proposes that by adopting a beginner's mind, instructors will be able to mitigate the disharmony. To adopt a beginner's mind, an instructor must first recognize any priors he holds that will be important for understanding the topic that differ from the priors that students likely hold. The best way to deal with these mismatched priors is to craft an experiment that develops the priors in a straightforward way (a beginner's mind experiment). The goal is to make the experiment itself the vessel that students learn through. Each beginner's mind experiment and lesson are composed of 3 phases: the warm up, the work and the cool down. The first phase of the beginner's mind experiment is the warm up while the beginner's mind experiment is the warm up phase for the entire lesson. The key takeaway is to remember that classroom experiments are fun and the fun you have running experiments will be even more meaningful when you are convinced students are learning a lot from the experiment.

JEL classification: A22, C90, H41

1. Introduction

In the beginners mind there are many possibilities, in the experts mind there are few

-Shunryu Suzuki (1973)

The curse of knowledge is explained by Wieman (2007) as the idea that when you *know* something, it is extremely difficult to think about it from the perspective of someone who does *not* know it. This is a very challenging problem for an instructor to overcome. One method to avoid such a curse may be to have students engage in an activity such as a classroom experiment. Classroom experiments are fun. Dixit (2005) and Kaplan and Balkenborg (2010) illustrate many ways to have fun in the classroom under the belief that fun leads to better learning. Yet, research is somewhat discouraging when it tries to quantify how much this fun leads to increased learning outcomes. Yandell (2004) and Durham, McKinnin, and Schulman (2007) both show a positive impact of classroom experiments on learning, but it is not a large impact. Part of this can be attributed to the goals of an economist using experiments for research. Experimental Economists have a well developed and rigorous methodology for running experiments on human subjects that meet various criteria the experimenter understands well and answers the questions the experimenter wants answered. Whether or not the subjects in the experiment gain any insight about economics from the experiment is not even a secondary concern, it is wholly irrelevant. So an instructor must do more than run an existing research experiment in the classroom if he hopes to achieve better student learning. There has been a lot of work done on modifying experiments to be used in a classroom setting, but most of these modifications focus on making the existing experiment feasible to run in a classroom, not necessarily to turn the experiment

into a teaching tool. Jaworski, Smith and Wilson (2010) address this issue by framing experiments as a path to discovery, which to the expert it seems obvious they would be, but in light of Yandell (2004) and Durham, McKinnin, and Schulman (2007) it appears that more work needs to be done than matching a topical lecture with an easy to use classroom experiment.

One way to improve is to attack the learning issue after the experiment has been run. Cartwright and Stepanova (2012) do this by having students write an essay for homework after participating in an experiment. Their results show that students who complete the writing assignment after the experiment score twenty percent higher on questions that correspond to the experiment than those students that did not do the homework assignment.

Alternatively, an instructor can modify the experiment using a beginner's mind framework to improve learning during the experiment. The first step in using the beginner's mind is to realize where the curse of knowledge strikes. When an instructor reads about an economics experiment and sees all of the wonderful and relevant issues at play, the curse of knowledge shows up and whispers *have your students play this experiment so they too will see all of these wonderful and relevant issues.* But the students are not experts. The experiment may not reveal the underlying principles to them. So, the instructor must now adopt a beginner's mind and ask what priors he holds that led him to seeing the wonderful and relevant issues. The instructor then has to focus on making sure that the students who will participate in the experiment are either informed or better yet allowed to discover and develop those priors. A major part of modifying an existing experiment to become a Beginner's Mind Experiment (BME) is concerned with making students comfortable and not assuming prior knowledge even if the students attended a lecture where they allegedly learned the topic.

2. How to Craft a Beginner's Mind Experiment

To get the students relaxed and ready for the BME, make sure to tell them something like: "how well you know economics is not that important for participating in this experiment. Economic researchers want to know what people actually do in certain situations. Since you are a person, you meet all the criteria for participating. You will only have a short amount of time to decide on a course of action, so just do what you think is best."

The next step is to ensure that the experimental instructions for the first treatment are trivially easy for the students to understand. In my personal experience, my students learn best when they are really confident and experience some early success. After they complete the first treatment, it is then the time to add in a little confusion. Since, they are confident, they are willing to exert effort on this more confusing task. In the last treatment, it is important to add clarity and have the students demonstrate to themselves that they understand. One can think of it as warming up, working hard and then cooling down being satisfied with what you did.

After the students have participated in the beginner's mind experiments, I follow up with discussion of the three treatments. The students then participate in a thought experiment that uses the experimental instructions from the experiment that was modified. A discussion follows.

To end the session, students complete a practice problem that corresponds to the experiments and then cover the basic theory. In fact, just as the beginner's mind experiment has three components (warm up, work, cool down) the entire lesson can be thought to have the same three components where the BME is the warm up, the thought experiment is the work and the practice problem and review of theory is the cool down.

When crafting a new BME, it is often helpful to think within the context of problem based learning (Forsythe 2002 and Rigall-I-Torrent 2012) and to focus on the four steps for designing problems/tasks. For the BME that I will describe in detail in the next section, the problem based learning design would be:

- The form of the PBL environment must be determined: The format for this activity best fits into the partial PBL criteria. There is a group of experiments, a thought experiment and lecture portion
- The instructor must focus on target learning outcomes: The main objective for the experiment is for students to develop a deep understanding of collective action. The experiment is also used as a framework to discuss behavioural game theory.
- Determine the learning activities associated to the PBL setting: The students will participate in a beginner's mid experiment. They will then go through a thought experiment with the instructor. The students will then be asked to complete a practice problem. The instructor will then go over the problem and give a very brief lecture.
- How to present the tasks to students: Students are broken up into groups of 4-9 members. Each group will need a dealer that is not participating in the experiment. Choose the appropriate amount of volunteers to become dealers. Students receive instructions for each treatment just prior to the start of the treatment. Each treatment is 5 rounds. After all treatments are completed, there is a discussion of the results. The instructor then reads out the instructions for the thought experiment. After discussion of the thought experiment, a problem is placed on the projector and students have 10 minutes to complete it. A discussion follows. Table 1 summarizes the order of the activities.[1]

- **Table 1** BME activities, tasks and schedule

Activity	Task	Schedule
	Presentation of the task	5
Experiments	Group Formation	5
	Instructions	5-10
	Treatment 1	10
	Instruction	3
	Treatment 2	5
	Instructions	3
	Treatment 3	5

[1] This experiment was designed for a two hour and fifteen minute block class. It is easily modified into two 1 hour sessions where the BME is run in session one and the thought experiment and review is covered in lecture two.

	Discussion of Results	10-20
Thought Experiment	Instructions	5
	Discussion/Debate	10-15
	Discuss Theory	
	Review Laboratory results	10-15
Lecture	Post Problem on Board	---
	Students Work Problem	10
	Go over answers	5
	Review Theory	5

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3. Beginner's Mind Experiment (Warm Up)

What follows is a detailed description of a beginners mind experiment crafted to meet the learning goal of a voluntary contribution method public goods game. The paper that inspired the BME is Isaac and Walker (1988). Holt and Laury(1997), later extended by Pickhard and Watts (2005), makes some nice modifications to the traditional voluntary contribution method public goods game that make it easy to administer in the classroom. Here are the relevant Holt Laury instructions:

> This is a simple card game. Each of you will be given four cards, two of these cards are red (hearts or diamonds), and two of these cards are black (clubs or spades). All of your cards will be the same number. The exercise will consist of a number of rounds. When a round begins, I will come to each of you in order, and you will play *two* of your four cards by placing these two cards face down on top of the stack in my hand. Your earnings in dollars are determined by what you do with your red cards. In each of the first five rounds, for each red card that you keep you will earn two dollars for the round, and for each black card that you keep you will earn nothing. Red cards that are placed on the stack affect everyone's earnings in the following manner. I will count up the total number of red cards in the stack, and everyone will earn this number of dollars. Black cards placed on the stack have no effect on the count. When the cards are counted, I will not reveal who made which decisions. I will return your own cards to you at the end of the round by coming to each of you in reverse order and giving you the top two cards, face down, off the stack in my hand. To summarize, your earnings for the round will be calculated:

This section will describe how to modify the traditional experiment, the implication of the modification, the result of running the modified experiment and a teaching note. The teaching note for each treatment will be listed with that treatment for the benefit of the reader. However, when running the experiment, the discussion does not take place until after the entire BME has concluded.

Treatment 1: The Warm Up

Instructions: This is a simple card game. Each of you will be given 4 cards, two of these cards are red and two of these cards are black. The exercise will consist of a number of rounds. When a round begins, you will place two of the cards face down in the hand of the dealer. Your earnings are determined by what you do with your red cards.

For the following 5 rounds, for each red card that you keep, you will earn 4 points, for each black card that you keep, you will earn nothing. Red cards that you hand to the dealer affect everyone's earnings in the following manner. The dealer will count up all of the red cards turned in, each member in the group earns 1 point for each card turned in. The dealer will then return your cards to you.

At the end of 5 rounds, the group member with the most points is the winner and they will receive 2 pts on the next exam. (1 winner per group)

Implication of BME Incentive Structure: All students should keep all cards. This strategy does not differ from the solution to the traditional game, but the new incentive structure does not allow for students to fare better through any type of coordination scheme. By using a tournament style payoff any student that does not play the dominant strategy in round 1 has already likely lost the game

Result: As surprising as it may seem, some students contribute to the public good early on in this game. However, contributions to the public good generally cease by round two.

Teaching Note: Normally, any source of confusion on the students end comes from them not making a strong effort to analyze the instructions. It is as if some students realize they have three options (contribute 0, 1 or 2 red cards), and they will play around the first round and see what happens. Economists running experiments for research will often conduct practice rounds to avoid experimental subjects who clearly do not understand the rules contaminating the data. Data contamination is not a concern for classroom games but instructors should again be mindful that even the simplest instructions may be ignored by participants, so the actions in the early BME treatment should lead to quick learning. For example, one can think of the winner's curse. Once you win a common value auction you should have an "Aha!" moment where you realize you overpaid. Similarly, a student that misplays an early round of a BME should have an "Aha!" moment that can be quickly corrected.

Treatment 2: Work

Instructions: For the following 5 rounds, for each red card that you keep, you will earn 4 points, for each black card that you keep, you will earn nothing. Red cards that you hand to the dealer affect everyone's earnings in the following manner. The dealer will count up all of the red cards turned in. Each member in the group earns 1 point for each card turned in. The dealer will then return your cards to you.

At the end of 5 rounds, the group with the highest cumulative earnings will be declared the winning team. The group member of the winning team with the most points is the winner and they will receive 3 pts on the next exam. (1 Winner in class)

Implication of BME Incentive Structure: Students should keep all red cards. Again, the predicted behaviour here is the same as in the traditional game.

Result: Most students deviate from the optimal strategy while few play the optimal strategy thus making this treatment rich for discussion after the experiment has ended.

Teaching note: It is clear what was motivating the behaviour of the red card keepers, but interesting to discuss what the contributors were doing. Some students that contributed early stated that they hoped

others would also contribute both cards and then their group would win and the winner would be chosen from their group since they all had the same amount of points. Some contributed early strategically with plans of later defection. Most interestingly, one student stated that she just "really wanted her team to win" and a few students nodded in agreement with this statement.

Here is a good opportunity to discuss behavioural economics. I like to point out that the game play of the contributors may seem odd, but it is not rare in lab experiments. For some reason being in a group makes people cooperative, see: Chen and Li (2009) and Chen and Chen (2011).

Treatment 3: The Cool Down

Instructions: At the end of 5 rounds, the group with the highest cumulative earnings will be declared the winning team. Each group member of the winning team will receive 2 pts on the next exam. (Each member of winning team is awarded points)

Implication of BME Incentive Structure: All students should contribute all red cards.

Result: Nearly all individuals contribute all red cards. Students that do keep cards in the first round of the treatment quickly realize their mistake and contribute all red cards in subsequent rounds.

Teaching note: The instructor will likely have to break ties after this treatment. Ties are also possible for Treatments 1 and 2 (but less likely). A simple way to do this is with a coin toss, but then the instructor has to determine which team gets to "call it". In my class, I have the teams that are tied nominate member to play rocks-paper-scissor (best 2 of three and round robin format if an odd number of teams are tied).

While Treatment 3 of the BME totally eliminates any incentive for the students to keep cards, it can be used as a jumping off point to discuss the use of teams to mitigate free riding. See Tan and Bolle (2007) and Guillen and Merrett (2011) for research experiments that could be modified with the BME process to build upon the experiment discussed here or as additional thought experiments.

Before moving on to the thought experiment is a good time to take questions and ask if students can think of any real world situations that match up with the various treatments of the experiment.

4. Thought Experiment (Work)

For this portion of the activity, the students are presented with the instructions to the original Holt and Laury (1997) game. They are then instructed to imagine playing the game and focus on what they would do as well as what other members of their group would do.

Implication of Incentive Structure: Students should keep all red cards

Result: The students are conflicted about what to do. Some say they would keep all, others mention many iterations of what they would do e.g. I would do this the first round and then see what the rest of the group did; others are convinced that all members should give all.

After the discussion has gone on for a few minutes post something similar to the following. Inform the students to take the labels as strong language that is meant to help them remember:

Imagine you are the student; you read the instructions and decide upon a plan of action. You may have one or more of the following thoughts about what you should do.

1. Contribute. The social optimum is for all to contribute, so clearly, the correct thing to do is for all of us to contribute. (The sucker)

2. Keep everything. No matter what anyone else does, it is best for me to keep my stuff (The slime ball)

3. Contribute, others may be afraid to, but when they see me contribute, they will realize it is best and join me (The leader)

4. Contribute early, get others contributing, and then stop contributing (The con artist).

Teaching Note: The students often have a very positive reaction to the labels and even debate the validity of the labels chosen. After some prodding and leading questions, the students start to realize that at the end of the game, people are not likely to contribute and then we focus on backward induction. Right when the students might start getting convinced that no one will ever contribute, I put up the actual result from Isaac and Walker (1988) (Figure 1) and ask the students to explain what they see. In Figure 1, the solid lines are the relevant lines to look at because subjects were not allowed to speak with each other in that treatment. If time allows, bringing up the impact of communication on outcomes is interesting (the dashed line in the top right corner shows the result of allowing communication).

Figure 1 Result from Isaac and Walker 1988

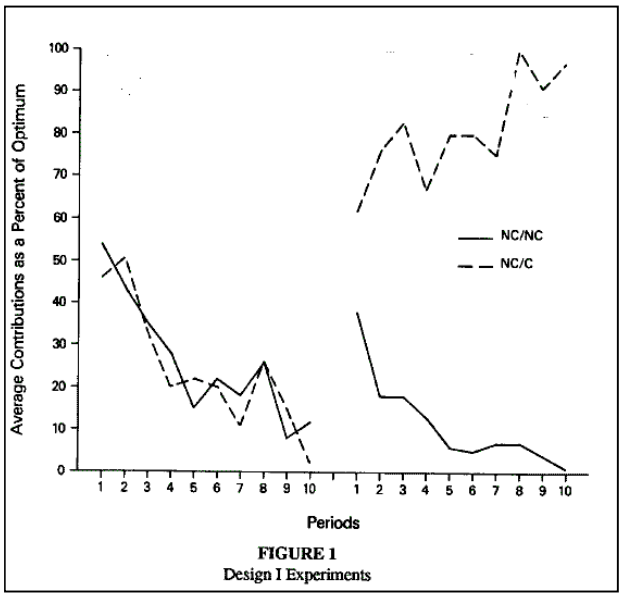

FIGURE 1
Design I Experiments

5. Ending the Lesson

To end the lesson, student should complete a problem similar to what they will be expected to complete on an exam. This is to reinforce what they have just learned and to get them comfortable with expressing what they have learned formally, e.g.:

There are 6 players each with 2 tokens. The players will play a simultaneous game. Players can either keep the tokens for themselves or contribute tokens to the pot. Any tokens kept by the player pay the player who kept the tokens, and only that player, $2 each. So if a player keeps 2 tokens he receives $4, but the other players receive nothing from those 2 tokens. The tokens in the pot are counted and every player in the group receives $1 for each token in the pot. So, if there are 6 tokens in the pot then each player receives a payout of $6 from the pot, regardless of how many he or she contributed. Thus the player's total payoff is $2 for every token kept plus $1 times every token in the pot.

a. What is the social optimum? That is, what type of play would lead to the most money for all of the players?
b. Why would that not be a Nash Equilibrium?
c. Do the players have a strictly or weakly dominant strategy? Is so, what is the strictly or weakly dominant strategy? If not, explain why not.
d. Find the pure strategy Nash Equilibrium to this game.

To complete the session, go over the answer to the problem, review the basic theory and take questions.

6. Conclusions

The experiment and lesson developed in this paper aimed at dealing with the curse of knowledge, or the disharmony between what instructors believe they are teaching and what students are actually learning. This paper proposed that by adopting a beginner's mind, instructors will be able to mitigate the disharmony. To adopt a beginner's mind, an instructor must first recognize any priors he holds that will be important for understanding the topic that differ from the priors that students likely hold. The best way to deal with these mismatched priors is to craft an experiment that develops the priors in a straightforward way (a beginner's mind experiment). The goal is to make the experiment itself the vessel that students learn through. Each beginner's mind experiment and lesson are composed of 3 phases: the warm up, the work and the cool down. The first phase of the beginner's mind experiment is the warm up while the beginner's mind experiment is the warm up phase for the entire lesson. The key takeaway is to remember that classroom experiments are fun and the fun you have running experiments will be even more meaningful when you are convinced students are learning a lot from the experiment.

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